1. 应用冲激信号的抽样特性求解

(1) $\int_{-\infty}^{+\infty} f(t-t_0)\delta(t)dt = \int_{0^-}^{0^+} f(t-t_0)\delta(t)dt = f(-t_0)\int_{0^-}^{0^+}\delta(t)dt = f(-t_0)$

(2) $\int_{-\infty}^{+\infty} f(t_0-t)\delta(t)dt = f(t_0)$

(3) $\int_{-\infty}^{+\infty} \delta(t-t_0)\cdot u(t-2t_0)dt = u(-t_0)$ 即 $t_0<0$，结果为1；$t_0>0$，结果为0，$t_0=0$，函数一般在该点无定义

(4) $\int_{-\infty}^{+\infty}(t+\sin t)\cdot\delta(t-\frac{\pi}{6})dt = \frac{\pi}{6}+\sin\frac{\pi}{6} = \frac{\pi}{6}+\frac{1}{2}$

(5) $\int_{-\infty}^{+\infty} e^{-j\omega t}(\delta(t)-\delta(t-t_0))dt = \int_{-\infty}^{+\infty} e^{-j\omega t}\cdot\delta(t)dt - \int_{-\infty}^{+\infty} e^{-j\omega t}\cdot\delta(t-t_0)dt = 1-e^{-j\omega t_0}$

2. 信号 $f(t)=2\cos(10t+1)-\sin(4t-1)$ 的周期的求解

$2\cos(10t+1)$ 的周期为 $\frac{2\pi}{10}=\frac{1}{5}\pi$；而 $-\sin(4t-1)$ 的周期为 $\frac{2\pi}{4}=\frac{1}{2}\pi$

由于二者周期比为有理数，则 $f(t)$ 为周期函数，周期为二者最小公倍数 π

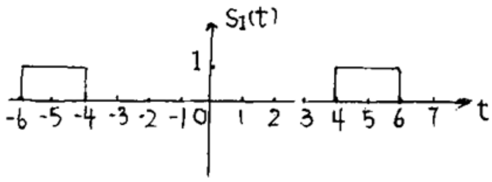
3. 已知 $f_1(t)=u(t+1)-u(t-1)$，$f_2(t)=\delta(t+5)+\delta(t-5)$

(1) $S_1(t)=f_1(t)*f_2(t)$

$= \int_{-\infty}^{+\infty}(u(\tau+1)-u(\tau-1))\cdot(\delta(t+5-\tau)+\delta(t-5-\tau))d\tau$

$= \int_{-\infty}^{+\infty}(u(\tau+1)-u(\tau-1))\delta(t+5-\tau)d\tau + \int_{-\infty}^{+\infty}(u(\tau+1)-u(\tau-1))\delta(t-5-\tau)d\tau$

$= u(t+6)-u(t+4)+u(t-4)-u(t-6)$ 卷积波形如下：



(2) $S_2(t)=\{(f_1(t)*f_2(t))(u(t+5)-u(t-5))\}*f_2(t)$

$= (u(t+5)-u(t+4)+u(t-4)-u(t-5))*f_2(t)$

$= (u(t+5)-u(t+4)+u(t-4)-u(t-5))*(\delta(t+5)+\delta(t-5))$

$= \int_{-\infty}^{+\infty}(u(\tau+5)-u(\tau+4)+u(\tau-4)-u(\tau-5))\cdot\delta(t+5-\tau)d\tau$

$+ \int_{-\infty}^{+\infty}(u(\tau+5)-u(\tau+4)+u(\tau-4)-u(\tau-5))\cdot\delta(t-5-\tau)d\tau$

$= u(t+10)-u(t+9)+u(t+1)-u(t-1)+u(t-9)-u(t-10)$ 卷积波形如下